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Pension Reform in Russia

A General Equilibrium Approach

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This paper uses a classic, overlapping generation model to analyze the optimal transition of the Russian economy from a PAYG pension system to a funded pension system. The transition is associated with the accumulation of social capital gained by increased contributions to the pension system. The analysis of the two-period model defines the optimal rule for the choice of the present value of the pension package as a function of aggregate capital stock in the economy.

In the numerical simulation, the large-scale dynamic model of the Russian economy is used to compare the welfare efficiency of three transition scenarios. All the scenarios assume that the economy shifts from a steady state with a PAYG pension system to a steady state with funded pensions though the speed of transition differs among the scenarios. The analysis suggests that transition to a funded pension system produces social welfare gains and allows one to choose the efficient transition trajectory. However, Pareto-improving transition is not achievable in the model since some age cohorts have to pay greater contributions to the pension system in order to initiate the accumulation of social capital.

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NON-TECHNICAL SUMMARY

Data on the social security system in Russia might suggest that the performance of the pension system has been improving steadily over the past two years. Indeed, the surplus of the Pension fund has increased from about zero in 1999 to 0.9% of GDP in 2000 and may reach 1.3% of GDP in 2001. At the same time, the average pension grew by more than 20% in real terms over the past year. The average pension now equals 90% of the minimal subsistence level and is expected to exceed it already this year. Yet, more thorough analysis demonstrates that the improvement was merely due to increasing wages on the back of strong economic growth. The ratio of the average pension to the average wage in the economy has remained stable over the past 2 years at about 32 – 34%, which is a maximum for Russia, given its worker/retiree ratio and the existing contribution rate. Meanwhile, the burden the pension system levies on younger generations is excessively high: at present, workers are required to pay as much as 28% of their wages to the Pension fund.

With an aging population (the average life expectancy now is only 66 years compared with 69.2 years in 1990, but it has been growing steadily since 1996) and a declining birth rate, the system may run out of funds very soon. The worker/retiree ratio will begin to fall in 2010 as those born right after WWII retire, and the ratio will sink further to about 1 by the year 2050.

The only alternative to a PAYG pension system, where workers pay pensions to retirees, is a funded system where younger generations accumulate assets to finance their retirement living. A funded system obviates a number of shortcomings of the PAYG system, namely demographic and political risks, and better suits the concept of a market economy, where people ensure their own well-being in old-age. Yet, a funded system requires a sound financial system that will secure individual savings and guarantee some minimal return.

The choice of the trajectory of transition from the PAYG system to a funded pension system is the central problem for pension system reform. One need remember that during the transition working generations have not only to accumulate funds for their own pensions but also to finance pensions for existing retirees (unless authorities decide to default on the implicit debt to retirees). Thus, the burden of double taxation is unavoidable. The speed of transition to a funded system may vary significantly. The state may prefer to pay off all the implicit debts to retirees at once at the cost of higher taxes for working people or it may protract the process for many years. The natural constraints that arise during the transition are related to the minimal pension size and to the maximum pension tax rate. The two must, at a minimum, guarantee social stability during the period of reform.

In our paper we use a classic overlapping generation model to study the issue of optimal transition from the PAYG pension system to a funded one. The goal of the paper is to estimate the feasibility of such a transformation, to establish the rules for choosing an optimal transition policy, and to work out practical recommendations as to how this transition policy could be best implemented. The transition policy in the model is conceived as a sequence of rates of contribution to the pension system and replacement rates.

At the numerical simulations stage, three scenarios of transition to a funded pension system are compared using a large-scale dynamic model of the Russian economy. All the scenarios assume that the economy moves from a steady state with the PAYG pension system to a steady state with funded pensions, though the speed of transition differs among the scenarios.

The scenario that yields the highest welfare gains assumes that the rate of contribution to the pension system (effectively the tax rate paid to the pension system net of tax evasion) is increased by one-fourth at the beginning of the transition in order to initiate the accumulation of social capital. This rate is kept at 25% for the first 24 years, then it gradually declines to 5%, by 5 percentage points every three years. Individual utility in the new steady state with a funded pension system is 5.8% higher than that in a steady state with the PAYG pension system. However, the welfare gain from the reform is only 0.8%, as some generations suffer higher taxation during the transition and the depth of reform is limited. The highest burden the optimal transition scenario imposes on individuals is about 0.4% of their life-time utility. The model predicts long-run macroeconomic gains, including an 8.6% increase in the stock of capital in the economy, by replacing the PAYG system with a funded system that possesses own capital stock. The total output per worker increases by 5.1% under a funded pension scenario.

The other two scenarios assume that the transition goes faster or slower and imply lower social utility gains for the given parameters of the model. In the model we assume that the individual discount rate is as high as 11% in order to reflect individual myopia. However, if the discount rate declines below the 8.7% threshold, faster transition becomes preferable.

Our analysis suggests that the transition to a funded pension system produces a social welfare gain. However, a Pareto-improving transition is not achievable in the model since some age groups must increase their contribution to the pension system to initiate the accumulation of social capital.

1. INTRODUCTION

The market transformation in the former Soviet Union (and other post-communist countries) had a negative impact on the system of social security and insurance. Although this system suffered specifically from planned economy inefficiencies, the original system provided a certain level of social guarantees to a wide range of the population. The social support system developed the habit of receiving social protection, free or with significant subsidization. The state has had to eliminate many social benefits it had earlier provided to individuals. Market reforms resulted in partial or complete privatization of some activities traditionally embraced by the public sector, for instance, health care, education, insurance, and, to some extent, the provision of retirement benefits. A growing differentiation of income has made most of the privatized services unfeasible to low- and even middle-income groups of population. This implies that social services urgently need reforming. The project focuses on the reform of the pension system, aimed at increasing efficiency and mitigating the redistribution conflicts.

The need to reform the pension system in Russia also stems from the vicious nature of the current pay-as-you-go (PAYG) redistributive scheme. In order for such a system to work satisfactorily, it requires a constantly low ratio of retirees to working people and sustainable growth of real wages. Only then can the implied return of the pension system be sufficiently high. In Russia both of these conditions tend to be violated. Real wages have been decreasing constantly over the 1991–1998 period. The demographic structure has not improved either. Due to a high number of different privileges (earlier retirement, for instance) and the aging population, the ratio of retired people to working people will decrease further. Currently, the number of working people per one retiree is close to 1.7, which is, for instance, two times lower than in France.

However, the demographic structure will improve slightly in the upcoming decade when generations born during World War II will reach retirement age. Moreover, a relatively numerous cohort of people born in the eighties will enter the work force by that time. These changes will allow for the transformation of the PAYG pension system into a funded one by imposing no significant burden on the working people. All these circumstances justify the need for fundamental reform of social security and social insurance, which must be started in the near future.

The purpose of this project is to analyze the transition from a PAYG pension system to a funded one, to estimate the feasibility of such a transformation and to work out practical recommendations for how this transition policy could be implemented.

The strategy of our analysis is to study the major relations between model variables on a simplified theoretical model in order to find the basic principles underlying the optimal transition policy and to test various scenarios of transition on a computer model taking into account underlying dependencies between model variables.

There exists a vast amount of literature on the topic under consideration, represented by the pioneer work of Samuelson (1958) and Diamond (1965). In their work, the heterogeneity implied by the age structure of the population does not allow one to derive a simple expression for aggregate consumption and savings. Only the standard two-period model avoids the aggregation problem due to the extreme restriction of the demographic structure.

Blanchard (1985) made substantial progress toward developing a tractable, overlapping generation model with a reasonable demographic structure by assuming that individuals face a constant probability of death each period. Yaari (1965) employed a similar restriction, making the individual horizon finite. Weil (1987) proposed a similar framework where individuals live forever, but a new cohort is born every period. However, both Blanchard's and Weil's frameworks do not capture life-circle behavior. All living individuals are identical and have identical propensities to consume.

Our analysis needs to capture the life-cycle property to study the impact of the redistribution of income, both over time and between younger and older generations. The original model can also be easily transformed into a model where agents live longer than two periods.

For the numerical simulations, we use a large-scale dynamic model similar to that used by Auerbach and Kotlikoff (1987). The model is used to compare the welfare impact of three transition scenarios. The demographic structure of the model is calibrated in accordance with the demographic data of Goskomstat to approximate the structure and dynamics of the population of the Russian Federation. Similarly, the size of contribution to the pension system and replacement rate are chosen so as to closely reflect the size of the contribution to the pension system and the replacement rate existing in the Russian economy.

The analysis suggests that pension system reform allows social welfare gains though at the sacrifice of certain age cohorts. The relative size of those gains is rather small as we limited the depth the reform. The model, however, does not take into consideration a number of positive externalities the funded pension system may produce (*e.g.* Holzmann, 1997).

The next section is devoted to the theoretical analysis of the two-period model. The third section describes the calibration of the model for the numerical simulations. The results of the comparison of three transition scenarios are discussed in the last section.

2. THE MODEL

The model proposed for the analysis is a conventional, overlapping generation, general equilibrium model proposed by Diamond (1965). The model allows us to trace the impact of the changes in pension policy on individuals' consumption/savings decision and on the aggregate savings in the economy. However, our choices of model specification are limited in the case of the deterministic form of the model with perfect foresight. In particular, the non-stochastic form of the model allows us to divide the lifetime of every generation into only two periods: work and retirement. Since an individual's current consumption/savings choice depends on his expectations about the future, the determinacy of equilibrium requires a unique relation between model variables for consecutive moments in time. When the number of life periods exceeds two, the competitive equilibrium in the model is undetermined unless we change the perfect foresight assumption. The initial specification of the model imposes very strong restrictions on the demographic structure. On the one hand, this enables us to have a closed-form solution for aggregate consumption and savings. On the other hand, the model allows only a rough approximation of reality.

The attempt to increase the number of periods within an individual's life requires additional assumptions (other than perfect foresight) about an individual's expectations of the model variables in the future. The natural solution here is to reformulate an individual's optimization problem in terms of expected utility. The source of uncertainty is stochastic shocks in the production function. The inclusion of risks here is regarded as a way to cope with the indeterminacy of equilibrium. Separate analysis of risk aspects of the pension system must involve a financial markets submodel as well as a wider model of government. The government (or Treasury) is often treated as an issuer of safe debt while market returns are stochastic. This raises the question of an optimal portfolio of the pension system trust fund and an optimal pension scheme (defined-benefit or defined-contribution).

However, the decision rule for the optimal choice of consumption/savings is non-linear in general and does not have a closed-form solution. There are two approaches to the problem: drastic simplification of the model or numerical simulations (*e.g*. Bohn, 1998). Both approaches restrict our ability to carry out a theoretical analysis of risks.

To try to change the perfect foresight hypothesis, we assume that the total output in the economy is subject to multiplicative shocks in the form of a stochastic multiplicative factor in the production function:

$$\tilde{F}(K, L) = u F(K, L)\,, \tag{1}$$

where u is a non-negative random variable with some distribution function. If we additionally assume a Cobb–Douglas form, both the equilibrium interest rate r and wage rate w will have the same stochastic nature.

Agents in the model maximize their expected discounted utility. Stochastic dynamic programming reduces the multi-period problem to a sequence of simple, two-period problems. The corresponding Bellman equation characterizes the optimal intertemporal choice of consumption and has the following form:

$$U'(c_t) = \beta E_t R_{t+1} U'(c_{t+1})\,, \tag{2}$$

where β refers to an individual's discount factor; R_{t+1} is the gross interest rate between time t and time $t + 1$.

However, the explicit solution to that problem could be derived with very strong restrictions, either on the form of the utility function or on the stochastic nature of labor income and the interest rate. In particular, there are two main cases when an explicit solution could be obtained. The first one is the case of diversifiable labor income risk. The second is the case of quadratic utility. However, the assumption of a deterministic wage does not match the specification of the production sector in our model. The second assumption is also imprudent. The linear quadratic problem exhibits the certainty equivalence property and gives the solution for consumption as a constant share of an individual's discounted lifetime income. Since an individual's discounted lifetime income is the sum of random future wages discounted at random future interest rates, even the strongest assumptions about the nature of stochastic processes underlying w_t and R_t do not allow us to derive current consumption as a tractable function of the current level of capital or output. We, therefore, need to simplify the model to the case where agents live for two periods.

Thus, we assume that each person in the model lives for two periods. People work in the first period when they are young, retire in the second period when they are old, and then die leaving no bequests. There are two generations (young and old) alive at the same time. In every new period, a new generation of young people is born. The number L_t of newborns at time t is $(1 + n)$ times greater than the number of older people L_{t-1} born at time $t - 1$ (n is constant over time and refers to the rate of population growth).

Agents in the model work only one period, supplying inelastically one unit of labor. In the first period of their life, t, they receive real wage w_t and pay contribution τ_t. to the pension system. Individuals derive utility from consumption both when they are young and old. An individual born at time t consumes c_t^1 in the first period of his life and c_{t+1}^2 in the second period when he is retired. To finance their consumption in the period of retirement, young people save s_t in the first period. In the second period they receive capital income $s_t R_t$ and benefits from the pension system b_{t+1}.

Individuals maximize their lifetime utility V_t, treating wage rate, interest rate and pension policy parameters τ_t and b_{t+1} as given:

$$V_t = U(c_t^1) + \beta\, U(c_{t+1}^2) \to \max \tag{3a}$$

subject to budget constraints

$$c_t^1 = w_t - \tau_t - s_t\,, \tag{3b}$$

$$c_{t+1}^2 = s_t\, R_{t+1} + b_{t+1}\,. \tag{3c}$$

The production sector of the economy is given by the Cobb–Douglas production function

$$Y_t = F(K_t, L_t) = A\, K_t^a\, L_t^{1-a}\,. \tag{4}$$

Labor here is supplied inelastically and is proportional to L_t, the size of the young generation at time t. The supply of capital K_t in period t, is determined by the saving decisions of the young generation made in *period* $t - 1$ and by the capital stock of the pension system if it possesses some.

$$K_t = s_{t-1}\, L_{t-1} + K_t^s\,. \tag{5}$$

The Cobb-Douglas form of the production function lets us rewrite the production function in per-capita terms

$$y_t = A\, k_t^a\,, \tag{6}$$

where k_t is the effective capital/labor ratio.

The output in the economy is divided between consumption and investment:

$$K_{t+1} + L_t c_t^1 + L_{t-1} c_t^2 = Y_t = A K_t^a L_t^{1-a} . \tag{7}$$

In order to rewrite the resource constraint above in per-capita terms, we divide both sides of the equation by L_t:

$$(1+n) k_{t+1} + c_t^1 + \frac{1}{1+n} c_t^2 = y_t = A k_t^a . \tag{8}$$

We assume full depreciation here. One may equivalently think that depreciated capital is subsumed in the production function.

The pension system also has an intertemporal budget constraint. We assume that at time t the system possesses the stock of social capital K_t^s (or pension system trust fund). Contribution to the pension system, τ_t, which the pension system collects from the young generation, is added to the stock of social capital. Similarly, pension benefits to retired individuals b_t are subtracted from the social capital stock. The social capital together with private savings forms the stock of capital in the economy that is supplied to the production function. The social capital, therefore, earns interest at the market rate. The intertemporal budget constraint of the pension system is given by

$$K_{t+1}^s = L_t \tau_t - L_{t-1} b_t + R_t K_t^s . \tag{9}$$

Similarly, in per-capita terms it has the following form:

$$(1+n) k_{t+1}^s = \tau_t - \frac{1}{1+n} b_t + R_t k_t^s . \tag{10}$$

The model above allows negative private savings if the social capital is higher than zero. In this case individuals may borrow against a future pension. Due to the homogeneity of agents in the model, aggregate private savings would be negative as well, and the whole capital stock in the economy would be supplied by the pension system. This, however, is unrealistic and we restrict private savings to be non-negative. In the case of the PAYG system the stock of social capital is zero. The equilibrium in such a model requires private savings to be non-negative to ensure that the economy has non-negative capital. Hence, we assume $s_t \geq 0$.

2.1. Competitive Equilibrium

Equilibrium in the model will be a sequence of $\{c_t^1, c_t^2\}_t^\infty$, such that:

E1. Given the government's pension policy $\{\tau_t, b_t\}_t^\infty$ and the sequence of competitive interest rates and wages, the trajectory $\{c_t^1, c_{t+1}^2\}$ solves the individual's optimization problem (3) for all t. The individual optimization problem implies the following first-order condition:

$$U'(c_t^1) = \beta R_{t+1} U'(c_{t+1}^2) \,. \tag{11}$$

E2. Factor prices are competitive:

$$R_t = f'(k_t) = a A k_t^{a-1} \,, \tag{12}$$

$$w_t = f(k_t) - k_t R_t = (1-a) A k_t^a \tag{13}$$

for all t.

E3. The pension system budget constraint (10) is satisfied for all t.

E4. The aggregate feasibility constraint (8) is satisfied for all t.

Note that the aggregate feasibility constraint (8) implies equilibrium on the capital market, which requires private savings equal to total capital less social capital:

$$(1+n)(k_{t+1} - k_t^s) = s_t(w_t, R_{t+1}, \tau_t, b_{t+1}) \,. \tag{14}$$

Equation (14), together with the pension system budget balance (10), gives the law of motion of the total capital and the social capital in the competitive equilibrium.

The competitive equilibrium in the model, in fact, allows an arbitrary pension policy. We assume that the economy is initially in a steady state with the PAYG pension system. In the PAYG steady state, the pension tax rate τ^{PAYG} is defined by the desired replacement rate b^{PAYG} and the rate of population growth n:

$$\tau^{\text{PAYG}} = \frac{1}{1+n} b^{\text{PAYG}} \,. \tag{15}$$

2.2. Command Optimum

The command optimum in the economy defines how a central planner would allocate resources to provide for all future generations. The central planner maximizes the discounted sum of life-time utilities of all future generations

$$\sum_{t}^{\infty} \gamma^{t-1}\left[U(c_t^1) + \beta U(c_{t+1}^2)\right] \to \max , \tag{16}$$

subject to the economy's resource constraint (8)

$$(1+n)k_{t+1} + c_t^1 + \frac{1}{1+n} c_t^2 = y_t = Ak_t^{\ a} .$$

The central planner's first-order conditions are

$$\beta (1+n) U'(c_t^2) = \gamma U'(c_t^1) , \qquad t = t_0, \ldots, \propto, \tag{17}$$

$$(1+n) U'(c_t^1) = \gamma f'(k_t) U'(c_{t+1}^1) , \qquad t = t_0, \ldots, \propto. \tag{18}$$

Equation (17) is a condition for the optimal allocation between the generations alive at the same time. Equation (18) is a condition for the optimal intertemporal allocation.

2.3. Optimal Pension Policy

The central planner's first-order conditions (17) – (18) respect the individual's first-order condition under competitive equilibrium (11). In other words, both individual and central planner allocate resources over time efficiently. The source of inefficiency in the competitive economy is the allocation of resources between generations alive at the same time. Therefore, the task of a pension policy is to allocate consumption efficiently between the young and the old while the market itself will provide the intertemporal efficiency. Since the choice of individual consumption is determined from the individual optimization problem (2) – (4) and depends upon the set $\{w_t, R_{t+1}, \tau_t, b_{t+1}\}$, the task of the government is to choose $\{\tau_t, b_{t+1}\}$ so as to satisfy the central planner's first-order condition

$$\beta (1+n) U'(c_t^2(w_{t-1}, R_t, \tau_{t-1}, b_t)) = \gamma U'(c_t^1(w_t, R_{t+1}, \tau_t, b_{t+1})) \tag{19}$$

given the laws of motion of the total capital and the private capital in the economy and the factor markets equilibrium conditions. Note that the choice of optimal pension policy becomes the choice of the present value of the pension package $b_{t+1} / R_{t+1} - \tau_t$. As long as the government keeps the present value of the pension package unchanged, the individual's budget constraint and savings/consumption decisions also remain unchanged. The only parameter that varies together with the size of pension contribution and benefits is the composition of savings (private vs. social). In this case, the share of social savings in total savings goes up as τ_t increases. This can be seen by substituting the pension system balance (10) into the equation for capital balance (14). Therefore, the condition for optimal pension policy is

$$\beta(1+n)U'\left[c_t^2\left(w_{t-1}, R_t, \frac{b_t}{R_t} - \tau_{t-1}\right)\right] = \gamma U'\left[c_t^1\left(w_t, R_{t+1}, \frac{b_{t+1}}{R_{t+1}} - \tau_t\right)\right]. \quad (20)$$

Note that condition (20) as well as the two command optimum, first-order conditions do not define the optimal policy explicitly. Rather both sets of equations define the optimal dynamics of the control variable and additional assumptions should be made to obtain a solution in an explicit form.

To get an explicit solution for the optimal choice of pension policy parameters, we need to make assumptions about individual preferences. Since the condition for the optimal pension policy is a part of the central planner's first-order conditions, the explicit solution for the pension policy parameters could be obtained only if the central planner's optimization problem has an explicit solution. To insure that the problem has a closed-form solution, we assume logarithmic individual's preferences.

2.4. Logarithmic Utility Function

The solution to the central planner's optimization problem can be found using the dynamic programming method. The solutions we obtain for the optimal consumption of young and old individuals are as follows:

$$c_t^1 = \frac{\gamma(1-\gamma a)}{\gamma+\beta} A k_t^a, \quad (21)$$

$$c_t^2 = \frac{\beta\ (1-\gamma\ a)(1+n)}{\gamma+\beta} A k_t^a. \quad (22)$$

To solve explicitly for $b_t / R_t - \tau_{t-1}$ we need to substitute the individual's optimal choice of c^1 and c^2 into the central planner's first-order conditions (21) – (22). The solution of the individual maximization problem has the following form:

$$c_t^{1\ \mathrm{ind}} = \frac{1}{1+\beta}\left(w_t - \tau_t + \frac{b_{t+1}}{R_{t+1}}\right), \tag{23}$$

$$c_{t+1}^{2\ \mathrm{ind}} = \frac{\beta R_{t+1}}{1+\beta}\left(w_t - \tau_t + \frac{b_{t+1}}{R_{t+1}}\right). \tag{24}$$

Now we can derive the condition for the optimal pension policy:

$$\frac{1}{1+\beta}\left(w_t - \tau_t + \frac{b_{t+1}}{R_{t+1}}\right) = \frac{\gamma(1-\gamma a)}{\gamma+\beta} A k_t^{a} . \tag{25}$$

Substituting for k_{t+1} and R_{t+1} as a function of k_t from the aggregate feasibility constraint, we get the present value of the pension package:

$$\left[\frac{\gamma(1+\beta)(1-\gamma a)}{\gamma+\beta} - (1-a)\right] A k_t^{a} = \frac{b_{t+1}}{R_{t+1}} - \tau_t . \tag{26}$$

If we now assume that τ_t is not a lump-sum but proportional to the individual's wage at time t (*i.e.*, $\tau_t = \pi_t w_t$) and pension benefits are a constant share of the wage rate at time t + 1 ($b_{t+1} = \varphi w_{t+1}$, *i.e.*, the lagged replacement rate is constant over time) then the condition for the optimal pension tax rate π_t is

$$\pi_t = \phi \frac{\gamma}{1+n} - \frac{\gamma(1+\beta)(1-a\gamma)}{(\gamma+\beta)(1-a)} + 1 . \tag{27}$$

Therefore, the optimal pension tax rate is constant over time. If pension policy during transition in our model aims to keep pension benefits proportional to the average wage rate in the economy, the optimal strategy would be to fix the size of contributions to the pension system at some optimal level and to let the economy accumulate capital freely.

To see how the optimal rate of contribution for the pension system depends on the parameters of the model, we will check the sign of the derivatives of π_t with respect to the rate of population growth, n; individual and social discount factors, β and γ, production function parameter a; and replacement rate, ϕ. We assume that β, γ and a are positive and do not exceed unity. Replacement is also assumed to be positive while the rate of population growth may have either sign, although it can not be smaller than −1.

1. $\dfrac{d\pi}{dn} = -\phi \dfrac{\gamma}{(1+n)^2} < 0$.

This result suggests that higher population growth requires lower contributions to the pension system to sustain the same level of pension benefits for older generation. This is due to the fact that a higher rate of growth increases the ratio of the number of contributors to the number of beneficiaries within the pension system and eases the burden on every young agent of financing pensions for the older generation.

2. $\dfrac{d\pi}{d\phi} = \dfrac{\gamma}{1+n} > 0$.

The relation between the replacement rate and the rate of pension contribution is simple: higher pension benefits require higher financing from young people.

3. $\dfrac{d\pi}{d\beta} = \dfrac{\gamma(1-\gamma)(1-a\gamma)}{(\gamma+\beta)^2(1-a)} > 0$.

With the increase of the individual discount factor, agents in the models apply higher weight to the consumption level in the future. Then along the optimal path, the consumption of older people increases as β goes up. The rate of contribution to the pension system also rises, reflecting the higher optimal consumption of the retirees.

4. $\dfrac{d\pi}{d\gamma} = \dfrac{1}{1+n}\phi + (1+\beta)\dfrac{\gamma^2 a + 2\gamma\beta a - \beta}{(\gamma+\beta)^2(1-a)}$.

To find the sign of the second term of the sum, we assume that individual discount factor β is smaller than social discount factor γ and capital share in output a is between 0.5 and 1. In this case

$$(1+\beta)\frac{(\gamma^2 a + 2\gamma\,\beta\,a - \beta)}{(\gamma+\beta)^2(1-a)} \geq (1+\beta)\frac{(\beta^2 a + 2\beta\,\beta\,a - \beta)}{(\gamma+\beta)^2(1-a)} =$$

$$= (1+\beta)\frac{(3\beta^2 a - \beta)}{(\gamma+\beta)^2(1-a)}.$$

The numerator $3\beta^2 a - \beta$ is non-negative if holds $\beta \geq 1/3a$. For the lowest possible $a = 0.5$, individual discount factor β must exceed 2/3 to guarantee a positive sign of $d\pi / d\gamma$. The intuition behind the result is that a higher social discount factor implies higher capital stock in the steady state or faster capital accumulation along the transition path since higher weights are applied to the utilities of future generations. Then heavier taxation on younger people is required to maintain the optimal capital stock.

5. $$\frac{d\pi}{da} = (1+\beta)\frac{\gamma(\gamma-1)}{(\gamma+\beta)(a-1)^2} < 0 .$$

As the share of capital in the output, a, goes to unity (the production function becomes closer to linear), the optimal rate of contribution decreases. This is basically due to the reallocation of the output between production factors. Particularly, as parameter a grows, the share of labor in the total output goes down. Consumption of the young generation as a share of total output then also diminishes but faster than the condition for optimal allocation prescribes. Then the rate of contribution to the pension system must be decreased to compensate for a consumption decline.

2.5. Comparative Statics

2.5.1. Optimal pension system. The steady state of an economy that grows along the optimal path is characterized by the interest rate close to the sum of the rate of population growth and the social discount rate $(1-\gamma)/\gamma$. The precise expression for the steady state interest rate is

$$R^* = \frac{1+n}{\gamma} . \tag{28}$$

Then the steady state level of capital in the economy with an optimal pension system is

$$k^{\text{opt}} = \left(\frac{\gamma\, a\, A}{1+n}\right)^{1/(1-a)} . \tag{29}$$

This capital intensity k^{opt} satisfies the Modified Golden Rule. As the social discount factor approaches unity, the steady state capital intensity k^{opt} becomes equal to the Golden Rule (GR) capital intensity k^{GR}, where

$$k^{\text{GR}} = \left(\frac{\gamma\, a\, A}{1+n}\right)^{1/(1-a)} . \tag{30}$$

The GR capital level maximizes per-capita consumption. In this case the utilities of all future generations are treated with the same weight. The

GR capital intensity is higher than the capital intensity in the economy with an optimal pension system while the interest rate is lower in the GR.

The steady state present value of the pension package as a share of wage rate is given by equation

$$\mathrm{PV} = -1 + \gamma(1+\beta)\frac{1-a\gamma}{(\gamma+\beta)(1-a)}. \tag{31}$$

Therefore, the present value of the pension package in the steady state is positive and becomes zero as the social discount factor approaches one and the economy comes to the Golden Rule steady state. Since social savings and private savings are perfect substitutes, we may have any composition of capital stock in the MGR steady state. For instance, if the pension tax rate is set so as to leave an individual's after-tax income equal to his consumption in the first period ($\tau = \beta/(1+\beta)$, which implies zero private savings), then the whole stock of capital in the economy must be owned by the pension system. The share of the pension system's capital stock in the total capital in the GR steady state is given by

$$s(\tau) = 1 - \frac{1-a}{a}\left(\frac{\beta}{1+\beta} - \tau\right). \tag{32}$$

The share of pension system capital in the total capital in the Modified Golden Rule is

$$s^{\mathrm{MGR}}(\tau) = 1 - \frac{1}{\gamma a}\left[(1-\tau)(1-a) - \gamma\frac{1-\gamma a}{\gamma+\beta}\right]. \tag{33}$$

The share of social capital in the total capital stock increases as the desired pension tax rate τ grows.

For various parameters of the production sector and individual preference, the share $s(\tau)$ could be treated as an estimate for the economy's ability to evolve along the optimal steady state equilibrium path without external (the central planner's) intervention. Thus, for the same rate of pension tax, economies with technology closer to linear technology require a higher share of social capital. This also can be seen from equation (34), which shows the competitive equilibrium interest rate in the steady state when there is no social security system in the economy (pure competitive equilibrium).

$$r^{\mathrm{CE}} = \frac{a(1+\beta)(1+n)}{\beta(1-a)}. \tag{34}$$

The interest rate in the equation above is higher than the rate of population growth and, therefore, the level of steady state capital is lower than the Golden Rule steady state capital level.

Equation (34) demonstrates that the higher the share of capital in the total output *a*, the higher the interest rate in the competitive equilibrium and, therefore, the lower the stock of capital in the competitive equilibrium. Then, if we want to put the economy into the optimal steady state, a higher state intervention is required. As far as the individual discount factor is concerned, as the discount factor β decreases the economy may evolve along the optimal steady state path with a lower share of social capital. This is due to the fact that a lower discount factor implies lower optimal consumption for retirees and, therefore, less intervention is required to provide for the older generation.

2.5.2. The PAYG pension system. The steady state of the competitive equilibrium with the PAYG pension system is characterized by zero social capital, which implies

$$\tau = \frac{\beta}{1+n}. \tag{35}$$

The value of the steady state capital level can be found from equation (36):

$$(1+n)k^{\text{PAYG}} = w(k^{\text{PAYG}}) - \tau - \frac{1}{1+\beta}\left[w(k^{\text{PAYG}}) - \tau + \tau\frac{1+n}{R(k^{\text{PAYG}})}\right], \tag{36}$$

where k^{PAYG} refers to the steady state capital level under the PAYG pension system. The right side of the equation (which describes the total savings in the economy) is a decreasing function of τ. Taking k^{PAYG} as an implicit function of τ, we discover that the sign of $dk^{\text{PAYG}}/d\tau$ is negative as well. The increase in the PAYG pension tax rate decreases private savings (in a higher proportion if R^{PAYG} is higher than $1 + n$) and reduces the steady state capital level.

The present value of the pension package in the competitive economy as a share of labor income is given by

$$\text{PV}^{\text{PAYG}} = \tau\frac{n - r^{\text{PAYG}}}{1 + r^{\text{PAYG}}}. \tag{37}$$

Since the steady state interest rate of an economy with a PAYG pension system is higher than the rate of growth of the population, the present value of the pension package is negative. An increase in the pension tax, τ, reduces the value of the pension system package further. The negative impact of the PAYG pension system on an individual's welfare stems from the fact that the implied return on the individual's contribution to the PAYG pension system is equal to the rate of growth of the population, n, while private savings yield market interest rate, r_t, which is higher than n. The expression above, in fact, estimates the implied tax that every individual has to pay in order to finance the higher consumption of the first generation that enjoyed pension benefits while paying no contribution to the pension system.

2.6. Dynamics

In order to compare how economies with different pension systems accumulate capital, it is worth deriving the expression for aggregate savings in terms of its share in the total output. The optimal pension system forces the economy to save share γa of the total output. The evolution of capital then is given by

$$k_{t+1} = \frac{\gamma a}{1+n} A k_t^a . \tag{38}$$

An economy with no pension system saves only $(1-a)/(1+n)(1+\beta)$ of the total output. Therefore, the capital stock in the competitive equilibrium with no pension system evolves according to

$$k_{t+1} = \frac{1-a}{(1+\beta)(1+n)} A k_t^a . \tag{39}$$

For the same initial capital level k_t, an economy with the optimal pension system saves $\gamma a(1+\beta)/(1-a)$ times more than a pure competitive economy with no social security. Since the PAYG pension system decreases savings, the rate of capital growth in the PAYG pension system will be even lower.

The two-period model, due to an extreme simplification of the demographic structure, allows us to achieve the first-best allocation with only one control variable. This is because the only variables that must be regulated are the consumption levels of the old and young generations alive at same time while intertemporal efficiency is provided by market. However, in models with the number of periods more than two, the optimal pension policy should care about the consumption of many generations with only two control variables. The goal of the social planner in the case of a multi-period model remains the same: to maximize the discounted life-time utilities of all current and future generations. The first-order conditions (15), (16) are easily expanded to the case of many periods. The first-best allocation is characterized by the set of $2(N-1)$ equations. The first $N-1$ equations (40) describe optimal intertemporal allocation.

$$(1+n)U'(c_{t-1,\, j-1}) = \lambda\left[1+f'(k_t)\right]U'(c_{t,\, j}), \qquad j = 2, \ldots, N, \tag{40}$$

$c_{t-1,\, j-1}$ here stands for consumption of a generation of age $j-1$ at time $t-1$.

The conditions for optimal intergenerational allocation are

$$\gamma m_{j+1} U'(c_{t,\, j}) = \beta m_j U'(c_{t,\, j+1}), \qquad j = 1, \ldots, N-1, \tag{41}$$

m_j here stands for the share of the cohort of age j in the total size of the population. Combining both sets of equations (40) and (41) and assuming that the structure of the population is constant over time, we obtain

$$U'(c_{t,\, j}) = \beta(1+r_{t+1})U'(c_{t+1,\, j+1}), \qquad j = 1, \ldots, N-1. \tag{42}$$

Condition (42) coincides with the individual's first-order condition for the optimal allocation of consumption over time. Therefore, the market again allocates resources over time efficiently. The task of a pension system is to provide efficient intergenerational allocation in accordance with condition (41). Generally, the first-best allocation in the model with many-period lives is achievable only with age-dependent pension taxes on labor income.

3. CALIBRATION

3.1. General Strategy

For the simulation part, we assume that initially the economy is in the steady state with the PAYG pension system. The government announces its transition policy that consists of paths of pension tax rates and replacement rates. Then the economy starts to evolve along a new trajectory to the new steady state with a funded pension system. The new steady state is characterized by non-zero stock of social capital and a new contribution and replacement rate.

The model still possesses the perfect foresight property. The problem of indeterminacy in the case in which the number of periods in the model exceeds two occurs due to the inability of agents to form their expectations about future market returns.

The stock of capital k_t at time t depends on individuals' savings decision at time t, which, in turn, depends on individuals' expectations about the return on capital in the future periods $t + 1$, ..., $t + N - 1$. Similarly, the saving decisions of agents alive in future periods depend on their expectations about capital levels far distant in time. Thus, under the perfect foresight assumption, the cycle of expectations evolves endlessly. The natural approach to this problem is to assume that after some distant period, agents expect that the economy converges to a steady state. The task of the numerical simulation then is to choose the sustainable capital trajectory that lets the agents in the model form their expectation about future capital stock such that the resulting savings/consumption choice and capital stock match the trajectory. The capital stock in the new steady state depends on pension policy parameters and can be found either analytically or fitted through the substitution of particular pension policy parameters into a computer model. This lets us determine the expectations of agents in the model and solve the indeterminacy problem. Note that period T, after which we assume the economy comes to the steady state, may be and must be significantly more distant in time than period N, the time by which the government finishes implementing the transition policy. The important issue here is the sensitivity of the truncated model to the length of time after which we assume the economy reaches the steady state.

The time-frame of reforms is not strictly given as well and depends on the sustainability of the transition trajectory.

3.2. Demography

For the numerical simulation part, we use the model with agents who are alive for 15 periods, corresponding to adult ages 20 through 66 — the average life expectancy in Russia. Here we combine 3 years of actual life into one period. In the first 11 periods of their life, individuals receive labor income while in the other 4 periods they are retired. The initial weights of cohorts of different ages are adjusted to the demographic structure of the population in Russia in accordance with Goskomstat data. After calibration, the demographic structure in the model implies 1.7/1 workers/retirees ratio. It is close to the 1.6/1 ratio estimated using Goskomstat data. Every new period a new cohort is born. The new cohort is $1 + n(t)$ times larger than the preceding cohort. Although the rate of population growth in Russia, n, is currently negative and close to -0.003 (the total number of population decreases), we assume that it will grow over time up to 0.03, reflecting the approximate 1% annual population growth.

3.3. Individual Preferences

Each agent of cohort j at the beginning of his life chooses the perfect-foresight consumption path given the sequence of pension policy parameters so as to maximize his life-time utility:

$$V_t = \sum_{i=1}^{N} \prod_{t=1}^{i} \beta_t U(c_{t+i-1,\, i}) \,. \tag{43}$$

We assume that an individual's discount factor also varies with the individual's age. This assumption is very close to the geometric discounting concept. Laboratory and field studies demonstrate that discount rates are much greater in the short-run than in the long-run. To capture this effect, we assume that an individual's discount factor β_i increases with an individual's age, *i.e.*, an individual's discount rate $(1-\beta_i)/\beta_i$ declines with his age. The classic papers on geometric or hyperbolic discounting assume the following form of the individual utility function (*e.g.*, Liabson, 1996):

$$U = u(c_t) + \beta \sum_{i=1}^{T-t} \delta\, u(c_{t+i}) \,. \tag{44}$$

Hyperbolic discounting, however, implies time inconsistency of an individual's consumption choice. Dynamic inconsistency requires the modeling of an intrapersonal game where the players are temporally situated "selves." To avoid extra complexities, we assume that preferences are time-consistent, though the individual's discount rate increases with his age. Hence, the consumer at time 1 (self 1) expects that the discount rate between two moments in the future will be higher than the discount rate between the current period and future period. This conflicts with the hyperbolic discounting concept as the latter assumes that the discount rate between two moments in the future is lower than that between today and tomorrow. Moreover, empirical studies suggest that older people demonstrate a higher propensity to save out of disposable income. However, older people prefer a prudent savings strategy. In Russia, for instance, retired people are reluctant to purchase CDs or other types of assets. The largest part of savings by older people is mattress savings that yield no return and do not add to the stock of capital in the economy. Moreover, the average propensity to save is likely to be close to zero for older people, as their disposable incomes are too low to allow savings at all.

We assume that the initial discount factor β_1 equals 0.9 and decreases to 0.78 by the model age 15. We believe this allows better reflection of an individual's myopia though the preferences still remain time-consistent.

Here we assume an isoelastic utility function with a relative risk aversion coefficient also varying over an individual's life:

$$U_{t,j} = \frac{1}{1-\sigma(j)} C_{t,j}^{1-\sigma(j)} . \tag{45}$$

The choice of intertemporal elasticity of substitution $1/\sigma_j$ is a separate task. There is no unique opinion about the size of σ_j. In particular, Altig, Auerbach *et al*. (1997) in their simulation assumed σ equal to 4. Gorinchas, Parker (1999) estimated empirically the value of σ for the American economy. In their paper different methods gave different estimations: $\sigma_1 = 0.514$ and $\sigma_2 = 1.3969$. The demarcating value $\sigma = 1$ determines which effect in the individual's consumption/savings behavior prevails: the income or substitution effect. The case of $\sigma > 1$ implies that the income effect dominates and individual savings decreases as the interest rate grows. In our case $\sigma > 1$ can partially capture the positive effect of capital accumulation. In particular, although a higher level of capital stock in the economy lowers the return on capital, the corresponding development of financial institutions and financial market infrastructure makes investment more attractive. Moreover, the attitude toward risk varies over age cohorts, as Gorinchas and Parker (1999) suggest. We assume that initially σ is less that unity, which refers to a relatively high elasticity of savings with respect to interest rate changes. Over age, σ increases reflecting the more conservative saving behavior of older people. Thus, we assume that initially σ equals 0.6 and then growths over age to 1.2 for retirees.

3.4. Production

The production function in the model is given by the classic Cobb–Douglas production function, $Y = AK^a L^{1-a}$, with the capital's share in the total output equal to 0.6 and the share of labor income equal to 0.4. The value of a is chosen in accordance with the statistical data on the composition of output in Russia. The factor A in the production function is a scale parameter, which can include technical progress. We neglect technological progress, leaving *A* constant over time. The depreciation rate is set to 0.15.

3.5. Pension System

The rate of contribution to the pension system in the simulation part refers to the effective pension tax rate net of tax evasion. Although for the Russian economy, the duty to the Pension Fund is currently as high as 29% of individual's wage, we set the contribution in the pension rate model equal to 20% to take tax evasion into account. This figure is also in accordance with estimates based on the size of the Pension Fund's revenues/expenditures and the average size of monthly pension payments and wages. The replacement rate is set to 32%, exactly as Goskomstat's recent statistics suggests. The initial values of the model parameters above determine the initial steady state of the model.

Although the final goal of the transition might be a Golden Rule steady state, we are looking for alternative steady states, affordable and reachable in a reasonable time period. Examination of the Golden Rule steady state suggests that the share of social capital for any type of preferences exceeds the 50% level, which is inconsistent with a market economy.

The target rate for the pension tax is set to 5% in order to try to eliminate all distortions from taxation in the economy. Although almost any replacement rate is attainable with some corresponding stock of social capital, to limit the state intervention in the economy, we fix the replacement rate at 50%. In the resulting steady state, the share of social capital in the overall capital stock equals 14%.

4. NUMERICAL SIMULATIONS

4.1. Steady States

The initial steady state with the PAYG pension system is characterized by the interest rate equal to 0.59, which corresponds to the annual return of 17%. Individuals' life-time consumption and income have the following profile (see Fig. 1). The maximum individual's consumption level falls for ages 45 – 55, which corresponds to ages 15 – 18 in the model.

Asset holdings are depicted in the Fig. 2.

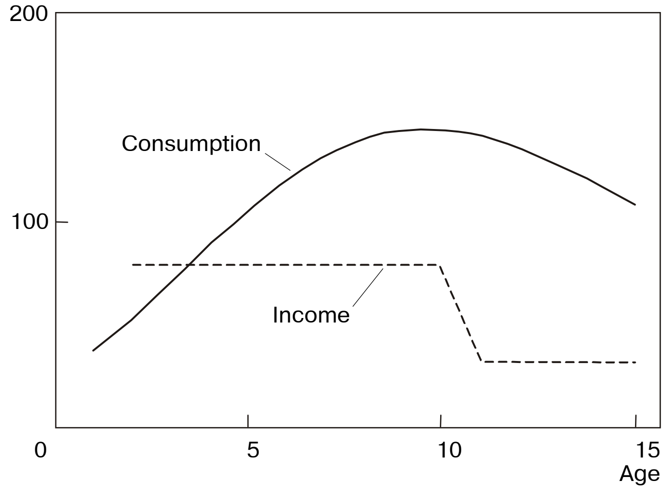

Fig. 1. Individual's income and consumption with the PAYG pension system.

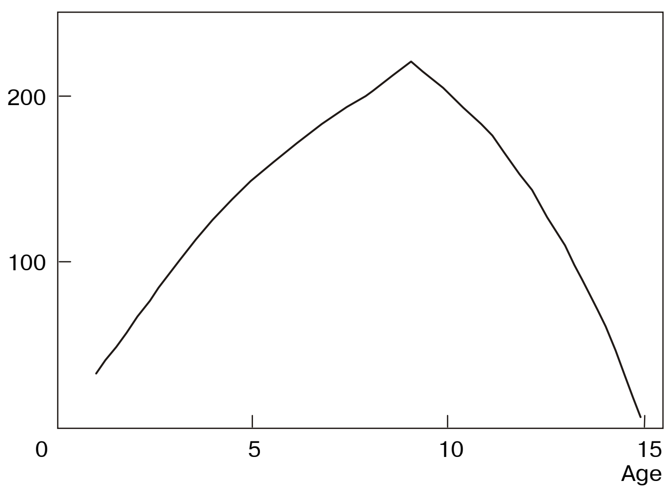

Fig. 2. Individuals' asset holdings with the PAYG pension system.

4.2. Funded Pension System

The total stock of capital in the steady state with a funded pension system is 8.9% higher than that in the steady state with the PAYG system. The social capital in the steady state accounts for 13.7% of the total capital stock. The interest rate is equal to 0.53 or 15% in annual terms. The consumption profile in the steady state with a funded pension system is similar to that in the steady state with the PAYG system. Individuals' consumption and income in the PAYG system are depicted in Fig. 3.

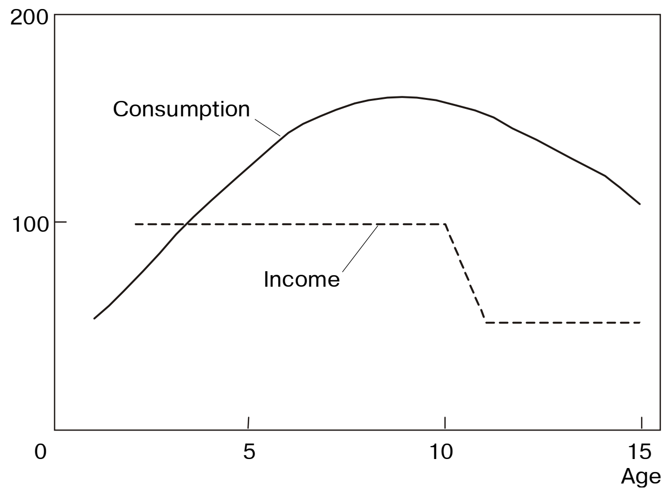

Fig. 3. Individuals' income and consumption with a funded pension system.

For comparison all the profiles are summarized in Fig. 4.

Although consumption over an individual's life under funded pensions is on average 11.7% higher than that in the PAYG case, the discounted life-time utility of individuals increases by only 5.8% after the transition to the new steady state.

The steady state private savings in the economy with the PAYG pension system are 6.3% higher than those under funded pensions. Asset holdings in the two steady states are illustrated in Fig. 5.

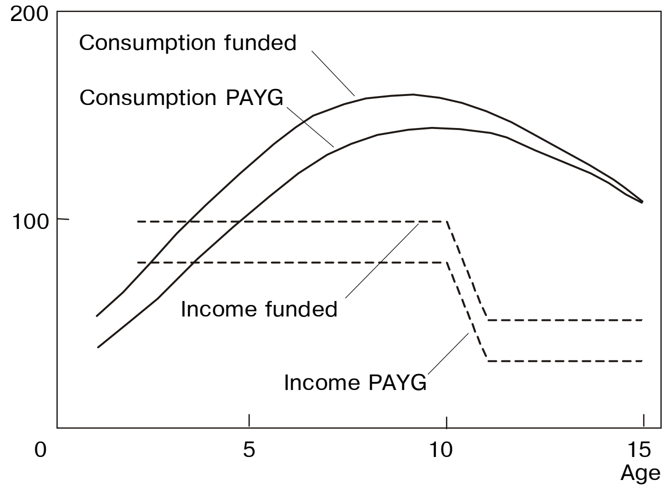

Fig. 4. Individuals' income and consumption with the PAYG and funded pension systems.

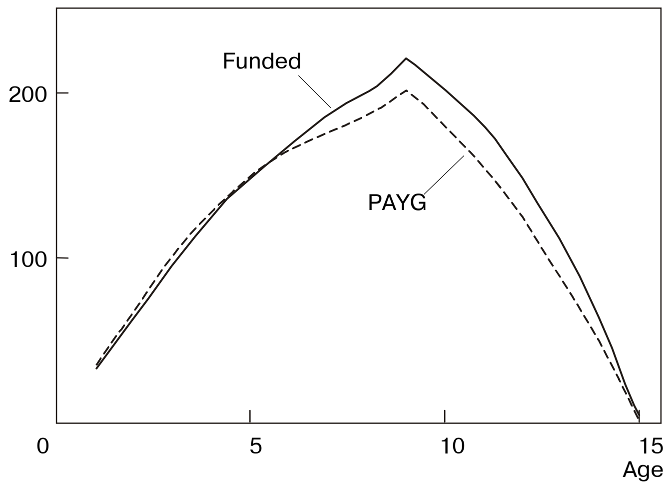

Fig. 5. Individuals' asset holdings with the PAYG and funded pension systems.

Note that the discounted life-time income in the equilibrium with funded pensions is 24.6% higher than that of the PAYG steady state. However, the analysis reveals that younger cohorts save almost equally under both systems while older people save more under the PAYG system. This is due to the substitution effect that offsets the increase in savings caused by the higher life-time income of every individual. Moreover, older people in the new steady state receive a substantially higher pension from the funded pension system and do not need to save as much as they save under the PAYG system.

4.3. Transition

An important constraint on transition policy is imposed by the characteristic of individual preferences. The partial derivative of total savings with respect to future capital levels is negative and declines in absolute value, as the capital variable becomes more distant in the future. As a result the attempt to accelerate capital accumulation with more intensive savings by a social security system is partially offset by a reduction in private savings. Then for a given path of the pension tax and replacement rates, the increase in expected future capital stocks will decrease an individual's savings and, therefore, lower the actual level of capital that will arise in the economy. This property rules out "bad" transition trajectories where, for instance, the economy starts to eat away all the capital stock, and this matches the expectations of agents in the model.

We have studied three scenarios of transition. For all scenarios we assume that the replacement rate starts to grow in the first period of transition and increases by 0.02 for every period up to 0.5. Therefore, the replacement rate reaches its steady state value after 10 periods.

The first scenario assumes accelerated transition. During the first 5 periods, the rate of contribution equals 28% and then it consequently reduces to 25%, 10%, 7% and finally 5%. Thus, after 7 periods the contribution rate and the replacement rate come to the steady state levels. Under the moderate transition scenario, the contribution rate is kept at 25% over the first 8 periods. Then it gradually declines to 5% stepping down by 5 percentage points every period. The slow transition scenario assumes only a 3 percentage point initial increase in the contribution rate. The contribution rate remains at the 23% level for 10 periods, then it goes down by 2 percentage points every period. Profiles for transition policy parameters are depicted in Fig. 6.

The "slow" scenario has the longest transition length. It lasts 20 model periods that corresponds to 60 years. The length of the "accelerated" scenario is twice as short as that of the "slow" one. The evolution of the capital stock under all three scenarios is depicted in Fig. 7.

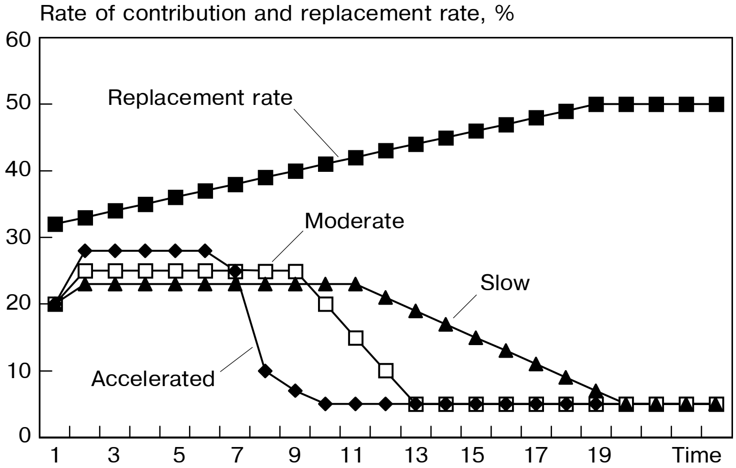

Fig. 6. Three scenarios of transition from the PAYG pension system to a funded pension system.

The capital stock gains 90% of the difference between the two steady state capital levels between the 9th – 15th periods of transition. As far as individual welfare is concerned, the generations mostly exposed to the transition burden are those near retirement. These generations have to pay in full the increased transition tax but can not enjoy the increased

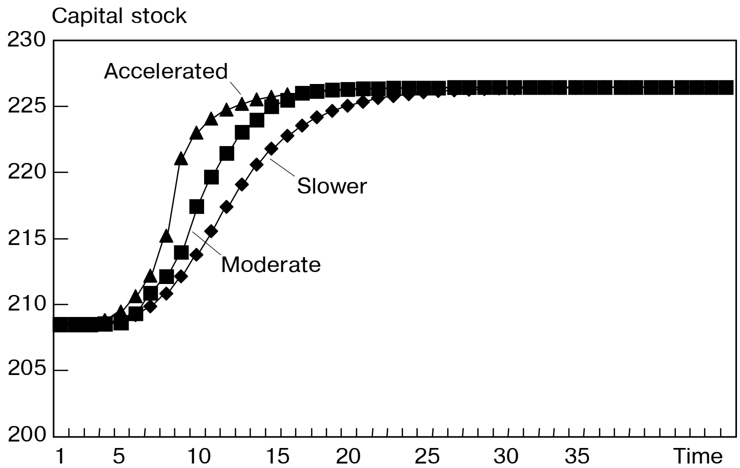

Fig. 7. Capital accumulation under three different scenarios.

pensions. The life-time utility of those generations under transition is depicted in Fig. 8.

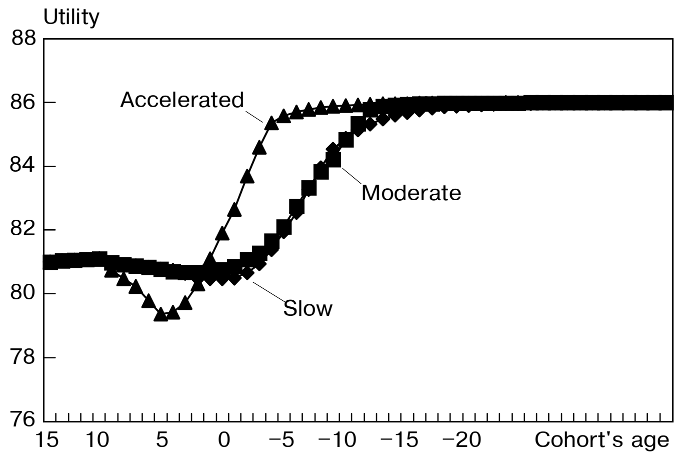

Fig. 8. The life-time utility of different age cohorts (negative ages refer to the cohorts not born at the time when the transition begins).

As it can be seen from the diagram, retired people benefit from the reform since they enjoy a higher replacement rate. Therefore, utility rises for generations of age 10 – 15. People who retire at the moment when the contribution rate goes down after the initial increase have the lowest utility levels. Most generations working at the moment when the transition starts (except for the two youngest ones) experience utility reduction under the "accelerated" scenario. Taking into account the fact that the number of people in the cohort decreases with the cohort's age, it becomes apparent that as long as individuals do not care about future generations, the accelerated transition policy is likely to gain support of less than 50% of the population. "Moderate" and "slow" scenarios, due to their longer period of higher taxation, are likely to gain even less support.

The highest burden that the accelerated transition imposes on individuals is about 2% of the individual's life-time utility, while for moderate and slow transition, the figures remain as low as 0.4% and 0.2% respectively. However, these estimates should not be treated as a reliable basis for making a policy choice since they closely depend on individuals' preferences. Another good indicator of the burden of transition is the maximal drop in the discounted life-time income. Our estimates suggest that the accelerated transition imposes a maximal burden of about 5% of an individual's life-time income. Moderate and slow transitions cost at maximum 3% and 2% of one's life-time income.

4.4. Social Optimum

We assume that the social discount factor γ is 0.9. In this case, the weighted sum of the life-time utilities of future generations reaches its maximum under the "moderate" scenario. The accelerated transition is less attractive for the central planner while slow transition is the worst option. Although the "accelerated" scenario implies substantial sacrifices for several generations that work during the period when reforms are initiated, the burden of the transition is offset by the faster growth of their utility in the future. As the social discount factor decreases (social discount rate increases) the "accelerated" scenario becomes less attractive. However, for a discount factor higher than 0.92, accelerated transition becomes preferable. Slow transition earns lower social utility for any discount factor.

Although the transition to a funded pension system yields a 5.8% utility gain when we compare individuals' utilities in the two steady states, social welfare increases by only 0.8% as a result of the transition. This is partly due to the relatively modest depth of the reforms. Social capital in the steady state accounts for less than 14% of total capital. For instance, in Great Britain, pension funds hold about one half of all domestic corporate equity. The same figure for the US is close to 25%. Thus, more radical reforms resulting in a higher proportion of social capital allow the economy to shift closer to the Golden Rule steady state. Welfare gains in that case would be greater. This holds when we assume that social capital is equally efficient as private capital. When social capital is less efficient compared with private capital, the accumulation of capital by the pension system may result in lower total output even if the overall capital stock increases in absolute value.

Although transition to a funded pension system allows a social welfare increase, Pareto-improving transition is not achievable in the model. Some generations still have to bear the burden of double taxation and the increased replacement rate is not able to compensate for it.

5. CONCLUSION

The transition scenario that yields the highest welfare gain suggests that the rate of contribution to the pension system must be increased by one-fourth from 20% to 25% to let the pension system begin to accumulate capital. In terms of individual utility, transition to funded pensions provides a notable gain of about 5.8% to the people fully covered by the funded pension system compared to those under PAYG pensions. However, a social welfare gain of about 0.8% is rather modest. This is due to the necessity of increased taxation during the transition period. The highest burden the moderate transition scenario imposes on individuals is about 0.4% of their life-time utility. Other transition scenarios imply lower social utility gains.

The model predicts long-run macroeconomic gains, including an 8.6% increase in the stock of capital in the economy, from replacing the PAYG pension system with a funded pension system that possesses its own capital stock. The total output per worker increases by 5.1% for those under funded pension systems.

Although the model is carefully calibrated to capture the basic properties of the Russian economy, it still suffers some shortcomings. First, the model lacks a financial system submodel whose task is to transform funds collected by the pension system into the economy's capital stock. We assume that pension contributions are directly channeled into the economy. However, should the pension system employ the financial market infrastructure to allocate money, a great number of other factors that affect market yields must be taken into consideration.

Secondly, the central planner in the model runs only the pension system while other types of state intervention are neglected. These are federal and local taxation, social insurance, etc. Each system runs its own budget, though spillovers between these budgets are also possible, for instance, financial aid from the Federal budget to the Pension Fund in Russia.

Thirdly, the model assumes an inelastic labor supply and taxation of individual incomes in favor of a pension system. However, in Russia's case, the pension tax is levied on employers instead of employees; changes in the pension policy parameters may affect both the labor supply and the demand for labor.

To conclude, although no transition scenario guarantees Pareto-improving transition, the pension system reform allows social welfare to increase. But the majority of people alive at the moment when the reforms begin have to bear the burden of higher taxation during the transition. When the decision on the pension system reforms is to be determined by majority voting, reforms are unlikely to gain enough support. Therefore, there is a difficult political dilemma about when to begin the transition. The experience of developed countries demonstrates that reforms may be postponed endlessly.

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